ENVIRONMENTAL PRODUCT DECLARATION

Prestressed precast concrete hollow core slabs

Constitute one m² of flooring able to support a load of 6 kN/m², and having a REI 60

Issued 2020-04-28
Valid until 2025-04-28

Third party verified
Conform to EN 15804+A1, NBN/DTD B08-001 and EN 16757

Cradle to grave

[B-EPD n° 200091-001-EN]

OWNER OF THIS ENVIRONMENTAL PRODUCT DECLARATION
FEBE

EPD PROGRAM OPERATOR
Federal Public Service of Health, Food Chain Safety and Environment
www.b-epd.be

The intended use of this EPD is to communicate scientifically based environmental information for construction products, for the purpose of assessing the environmental performance of buildings.

PRODUCT DESCRIPTION

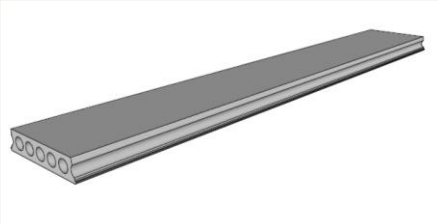
PRODUCT NAME

Prestressed hollow core concrete slabs

Produced by members of the federation of the Belgian precast concrete industry (**FEBE**).

REFERENCE FLOW / DECLARED UNIT

This EPD is 'cradle-to-grave'.
The functional unit for the EPD is 'Constitute one m² of flooring able to support a load of 6 kN/m², and having a REI 60´.
0,1 product is needed in order to fulfil the functional unit.
The quantity of material necessary to fulfil the function is 275,7 kg, of which 2,7 kg are steel and 273 kg are concrete.



Packaging is included.
Installation is included.
Ancillary materials for installation are included.

PRODUCT DESCRIPTION

The product has the following dimensions.

Dimension	Unit (expressed per product)	Value
Height	m	0,2
Length	m	8,5
Width	m	1,2

The hollow core prestressed is a precast slab of prestressed concrete typically used in the construction of floors in multi-story apartment buildings or utility buildings.

COMPOSITION AND CONTENT

The main components of the product are

Components	Value [kg] (expressed per product)	Value [%]
Cement	341,7	12,2
Coarse aggregates	1264,3	45
Sand	1008	35,8
Water	170,8	6,1
Steel	26,9	1

Wooden wedges are used for the transport.

The product does not contain materials listed in the "Candidate list of Substances of Very High Concern for authorization".

Reference service life

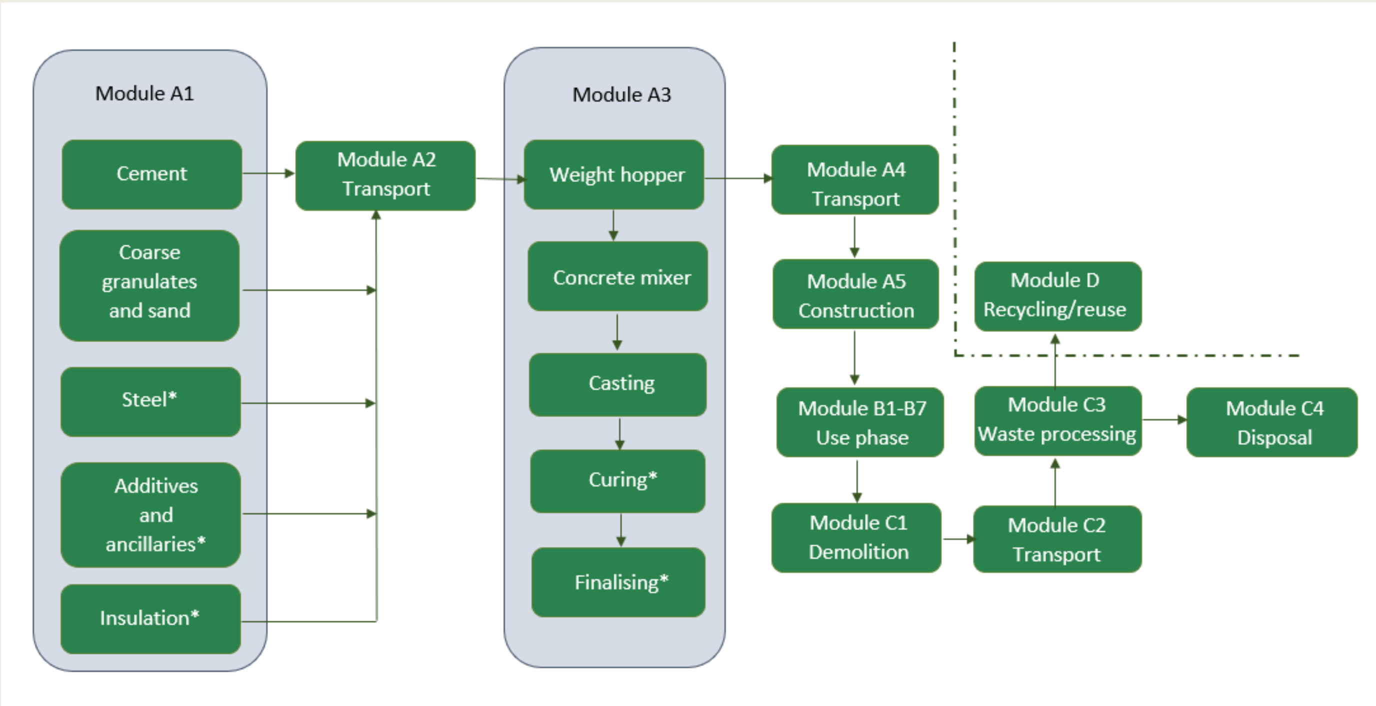
The reference service life is estimated at 100 years.

The used RSL is based on guidance provided by the PCR EN 16757 (Annex AA) and on FEBE expert judgement. It applies to all scenarios considered.

Description of the production process and technology

The production process includes the following steps:

- placing and tensioning of the prestressing steel on the casting bed;
- weighing of raw materials;
- production of concrete by mixing raw materials;
- casting of the bed by extruding or slipforming;
- curing and accelerated hardening of the concrete;
- detensioning of the strands and wires.



Technical data / physical characteristics

Technical property	Standard	Value	Unit	Comment
f_{pk} of steel	NBN EN 1992-1-1	1860	MPa	-

LCA STUDY

DATE OF LCA STUDY

Last update of the LCA model was carried out in June 2019.
Results for the EPD have been calculated on 2020-02-11.

SOFTWARE

This EPD is calculated and drafted with the help of the EPD tool developed by RDC Environment for FEBE. The LCA model and calculations use the software program *RangeLCA* 5.1.18, developed by RDC Environment. The tool allows FEBE members to establish generic or specific EPDs via a web-based interface.

INFORMATION ON ALLOCATION

Allocation procedures are according to the basic rules from EN 15804+A1. However, due to lack of data availability, impacts of blast furnace slag as co-product of steel production, are allocated by physical partitioning instead of based on economic value.

INFORMATION ON CUT OFF

In line with the standard EN 15804+A1, data gaps have been filled by conservative assumptions with average or generic data. The cut-off criteria are of 1% of renewable and non-renewable primary energy and 1% of the total mass input for these input processes. The total neglected input flows per module are less than 5% of energy usage and mass.
The following processes are considered below cut-off:

- Module A3: Labels on products
- Module A5: Packaging of installation products

INFORMATION ON EXCLUDED PROCESSES

In accordance with the standard EN 15804+A1, the following processes were excluded for the inventory:

- Module A5: Transport of packaging of installation products
- General: Infrastructures for pumping stations, and water sanitary stations; Storage of primary materials or (concrete) wastes.

INFORMATION ON BIOGENIC CARBON MODELLING

For bio-based packaging of finished products (cardboard and wood), biogenic carbon flows are not taken into account along the packaging life cycle (modules A3, A5 and D). Since end-of-life treatments are either incineration or recycling, there is no net contribution to GWP of such packaging end-of-life. Hence, biogenic carbon flows may be omitted, according to BE-PCR draft 4.1, section A 11.

Details on biogenic carbon originating from other processes than packaging are not provided separately since they contribute to global warming by typically less than 0,5% within each module.

INFORMATION ON CARBON OFFSETTING

Not applicable

ADDITIONAL OR DEVIATING CHARACTERISATION FACTORS

Not applicable

DATA

SPECIFICITY

The data used for the LCA are for a group of products which are manufactured in more than one production site.
The collective EPD covers products with equal dimensions fulfilling the same functional unit.
The average EPD is representative of the FEBE members producing the assessed product.

GEOGRAPHICAL REPRESENTATIVITY

The EPD is representative for the Belgian market.

PERIOD OF DATA COLLECTION

Manufacturer specific data have been collected for the year 2017.

INFORMATION ON DATA COLLECTION

For modules A1-A3 and A5, primary data is collected from FEBE experts and manufacturers.

Dimensions of the product and type of concrete are common to all producers. For A1-A3 modules, the covered products might differ by small variations in the concrete recipe and in the amounts of other materials, by differences in mode and distance of transport for raw material supply and in terms of energy consumption at the manufacturing plant.

As required by the EN15804+A1 standard (8.2.1.c.ii) and NBN/DTD B 08-001:2017 (A22), the calculation rules used to determine the average values are described in the following table for modules A1 to A3, i.e. the modules for which differences among sites/producers can be expected.

Module & Data	Rule for determining average / representative data
A1 - Concrete composition	Averaging rule: Composition provided by FEBE is obtained as unweighted average among all compositions reported by producers for the corresponding type of concrete.
A1 - Amount of steel	The amount of concrete and steel (for reinforcement, prestressed concrete or fibered steel) is calculated by FEBE engineers to fulfil the mechanical requirements of the product (in some cases, expressed through the load to be supported). The calculations take also the economical constraints into account. Averaging rule: None.
A1 - Amount of pigments	Provided by FEBE engineers, the amount of pigment is based on current typical practice. Averaging rule: None.
A2 - Transport from extraction to manufacturer	Estimated by FEBE experts, typical distance and transport modes, representative of the raw material supply transport, are used as reference values. Averaging rule: none.
A3 - On-site manufacturing	Data has been collected from FEBE members through questionnaires. Total amounts of electricity and fuels are divided by the total production in ton of the site, whatever the type of concrete products manufactured. Averaging rule: for each energy carrier, average use is obtained as mass weighted averages of the amounts of energy per ton obtained per production site. Data from 12 sites are used (3 sites with extreme values are excluded). Averages per ton are then converted in average values per m3 of concrete.
A3 - Packaging	Most representative values have been determined by FEBE experts with the help of producer surveys. Averaging rule: None.

DATABASE USED FOR BACKGROUND DATA

Modules	Type of data	Source	Year (of publication)
A1	*LCI dataset for raw materials, in particular:* *Cement (I and III)* *Natural coarse aggregate* *Artificial coarse aggregate* *River-sea-quarry sand* *Crushed sand* *Reinforcing steel* *Prestressing steel*	 CEMBUREAU Ecoinvent v3.5: Gravel production, crushed Ecoinvent v3.5: Expanded clay production Ecoinvent v3.5: Gravel and sand quarry operation – sand Ecoinvent v3.5: Gravel production, crushed Arcelor Mittal: EPD Rebar steel Worldsteel: Steel wire rod	 2015 2018 2018 2018 2018 2015 2018:
A4 – C1-C4	*Secondary data: Default transport and end-of-life scenario*	Belgian PCR NBN/DTD B 08-001:2017	2017
All	*Secondary: Other LCI datasets* *Truck operation*	Ecoinvent database, v 3.5. Copert 4	2018 2015

ENERGY MIX

Electricity for Belgium is modelled by using the consumption mix calculated with the help of country-specific data published by IEA in 2017 for the year 2015. LCIs of electricity production modes available in the ecoinvent v3.5 database are used.

PRODUCTION SITES

This collective EPD is representative of the following manufacturers:

ERGON NV, LIER
FINGO NV, HAM
FINGO NV, MALLE
INTER-SHIPPING NV, BORNEM
MEGATON NV, NINOVE
NERVA NV, HARELBEKE
PREFACO NV, HOUTHALEN
PREFACO NV, ZUTENDAAL
RONVEAUX (Ets E.) S.A., CRISNEE
STEENBAKKERIJEN VAN PLOEGSTEERT NV, PLOEGSTEERT
STRUCTO NV, BRUGGE

SYSTEM BOUNDARIES

Product stage			Construction installation stage		Use stage							End of life stage					Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Construction installation stage	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal		Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠		⊠

X = included in the EPD
MND = module not declared

POTENTIAL ENVIRONMENTAL IMPACTS PER REFERENCE FLOW

	Production	Construction process stage		Use stage							End-of-life stage				
	A1 Raw material / A2 Transport / A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
GWP (kg CO2 equiv/FU)	4,28E01	1,8	1,37E01	-1,76	0	0	0	0	0	0	1,57	7,24E-01	5,99E-01	8,66E-02	-5,88
ODP (kg CFC 11 equiv/FU)	1,24E-06	3,26E-07	7,96E-07	0	0	0	0	0	0	0	2,85E-07	1,31E-07	1,19E-07	4,84E-08	-2,88E-07
AP (kg SO2 equiv/FU)	1,07E-01	6,85E-03	4,73E-02	0	0	0	0	0	0	0	1,19E-02	2,75E-03	3,36E-03	1,01E-03	-1,55E-02
EP (kg (PO4)3- equiv/FU)	1,59E-02	1,23E-03	6,07E-03	0	0	0	0	0	0	0	2,58E-03	4,94E-04	6,33E-04	1,76E-04	-2,07E-03
POCP (kg Ethene equiv/FU)	9,81E-03	5,25E-04	3,08E-03	0	0	0	0	0	0	0	7,23E-04	2,11E-04	1,96E-04	7,98E-05	-2,59E-03
ADP Elements (kg Sb equiv/FU)	6,68E-05	7,01E-06	2,57E-05	0	0	0	0	0	0	0	5,38E-07	2,82E-06	3,02E-07	3,53E-07	-9,29E-05
ADP fossil fuels (MJ/FU)	2,89E02	2,78E01	1,13E02	0	0	0	0	0	0	0	2,27E01	1,12E01	8,87	4,09	-6,13E01

GWP = Global Warming Potential (Climate Change); ODP = Ozone Depletion Potential; AP = Acidification Potential for Soil and Water; EP = Eutrophication Potential; POCP = Photochemical Ozone Creation; ADPE = Abiotic Depletion Potential – Elements; ADPF = Abiotic Depletion Potential – Fossil Fuels;

RESOURCE USE

	Production	Construction process		Use stage							End-of-life stage				
	A1 Raw material A2 Transport A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
PERE (MJ/FU, net calorific value)	1,8E01	3,72E-01	3,67	0	0	0	0	0	0	0	1,38E-01	1,49E-01	7,01E-01	3,86E-02	2,43
PERM (MJ/FU, net calorific value)	6,14E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	-4,61E-01
PERT (MJ/FU, net calorific value)	1,86E01	3,72E-01	3,67	0	0	0	0	0	0	0	1,38E-01	1,49E-01	7,01E-01	3,86E-02	1,97
PENRE (MJ/FU, net calorific value)	3,29E02	2,84E01	1,16E02	0	0	0	0	0	0	0	2,29E01	1,14E01	1,37E01	4,15	-6,21E01
PENRM (MJ/FU, net calorific value)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PENRT (MJ/FU, net calorific value)	3,29E02	2,84E01	1,16E02	0	0	0	0	0	0	0	2,29E01	1,14E01	1,37E01	4,15	-6,21E01
SM (kg/FU)	1,13	0	1,3	0	0	0	0	0	0	0	0	0	0	0	0
RSF (MJ/FU, net calorific value)	1,87E01	0	9,36E-02	0	0	0	0	0	0	0	0	0	0	0	0
NRSF (MJ/FU, net calorific value)	1,46E01	0	7,29E-02	0	0	0	0	0	0	0	0	0	0	0	0
FW (m^3 water eq/FU)	5,92E-01	5,88E-03	1,81E-01	0	0	0	0	0	0	0	9,61E-03	2,36E-03	2,28E-03	3,52E-03	-5,22E-01

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water

WASTE CATEGORIES & OUTPUT FLOWS

	Production	Construction process stage		Use stage							End-of-life stage				
	A1 Raw material A2 Transport A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
Hazardous waste disposed kg/FU	4,14E-03	2,35E-05	2,52E-04	0	0	0	0	0	0	0	1,03E-05	9,43E-06	7,29E-06	2,92E-06	-1,63E-05
Non-hazardous waste disposed kg/FU	2,19	1,45	4,6	0	0	0	0	0	0	0	1,05E-01	5,84E-01	1,05E-01	1,75E01	-5,1E-01
Radioactive waste disposed kg/FU	4,23E-03	1,84E-04	6,97E-04	0	0	0	0	0	0	0	1,6E-04	7,41E-05	9,66E-05	2,73E-05	-1,83E-04
Components for re-use kg/FU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials for recycling kg/FU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,64E02
Materials for energy recovery kg/FU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exported electric energy MJ/FU	0	0	1,37E-02	0	0	0	0	0	0	0	0	0	0	0	0
Exported thermal energy MJ/FU	0	0	2,74E-02	0	0	0	0	0	0	0	0	0	0	0	0

IMPACT CATEGORIES ADDITIONAL TO EN 15804

	Production			Construction process		Use stage							End-of-life stage				
	A1 Raw material	A2 Transport	A3 manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
PM (kg PM2.5 eq/FU)	9,45E-03			6,09E-04	4,84E-03	0	0	0	0	0	0	0	2,37E-02	2,45E-04	4,75E-04	1,34E-04	-1,21E-03
IRHH (kg U235 eq/FU)	Impact category not declared																
ETF (CTUe/FU)	5,93			5,69E-01	6	0	0	0	0	0	0	0	3,23E-01	2,29E-01	1,6E-01	7,73E-02	-2,42E-01
HTCE (CTUh/FU)	2,3E-07			1,85E-08	7,51E-08	0	0	0	0	0	0	0	1,19E-08	7,42E-09	9,03E-09	1,61E-09	-1,25E-08
HTnCE (CTUh/FU)	2,34E-06			1,08E-07	1,22E-06	0	0	0	0	0	0	0	4,76E-08	4,35E-08	2,72E-08	1,01E-08	2,23E-07
WRD (m³ water eq/FU)	5,76E-02			9,53E-04	3,19E-02	0	0	0	0	0	0	0	1,56E-03	3,83E-04	3,69E-04	5,7E-04	-7,63E-02
LUO – SOM (kg C deficit/FU)	7,26			1,54E	3,96E	0	0	0	0	0	0	0	6,17E-02	6,20E-01	4,73E-01	3,58E-01	-3,26
*LUO – B, all (PDF*m²a/FU)*	Impact category not declared																
LUT – SOM (kg C deficit/FU)	6,04E+01			5,21	2,43E+01	0	0	0	0	0	0	0	3,80	2,09	4,20	3,49	-4,00E+01
*LUT – B, all (PDF*m²/FU)*	Impact category not declared																

	*LUO – B, u (m²a/FU)*u	Impact category not declared
	LUO – B, a (m²a/FU)	Impact category not declared
	LUO – B, f (m²a/FU)	Impact category not declared
	LUT – B, tr r (m²/FU)	Impact category not declared

HTCE = Human Toxicity – cancer effects; HTnCE = Human Toxicity – non cancer effects; ETF = Ecotoxicity – freshwater; PM = Particulate Matter; IRHH = Ionizing Radiation – human health effects; WRD = Water Resource Depletion: LUO – SOM = Land Use Occupation – SOM; LUO – B, all: Land Use Occupation – biodiversity ALL; LUO – B, u: Land Use Occupation – biodiversity Urban; LUO – B, a: Land Use Occupation – biodiversity agricultural; LUO – B, f: Land Use Occupation – biodiversity forest; LUT – SOM = Land Use Transformation – SOM; LUT – B all = Land Use Transformation – Biodiversity ALL; LUT – B, u = Land Use Transformation – Biodiversity Urban; LUT – B, a = Land Use Transformation – Biodiversity agricultural; LUT – B, f = Land Use Transformation – Biodiversity forest; LUT – B, tr r = Land Use Transformation – Biodiversity transition rainforest

Global Warming Potential	kg CO_2 equiv/FU	GWP	The global warming potential of a gas refers to the total contribution to global warming resulting from the emission of one unit of that gas relative to one unit of the reference gas, carbon dioxide, which is assigned a value of 1.
Ozone Depletion	kg CFC 11 equiv/FU	ODP	Destruction of the stratospheric ozone layer which shields the earth from ultraviolet radiation harmful to life. This destruction of ozone is caused by the breakdown of certain chlorine and/or bromine containing compounds (chlorofluorocarbonsor halons), Which break down when they reach the stratosphere and then catalytically destroy ozone molecules.
Acidification potential	kg SO_2 equiv/FU	AP	Acid depositions have negative impacts on natural ecosystems and the man-made environment incl. buildings. The main sources for emissions of acidifying substances are agriculture and fossil fuel combustion used for electricity production, heating and transport.
Eutrophication potential	kg $(PO4)^{3-}$ equiv/FU	EP	The potential to cause over-fertilization of water and soil, which can result in increased growth of biomass and following adverse effects.
Photochemical ozone creation	kg Ethene equiv/FU	POCP	Chemical reactions brought about by the light energy of the sun creating photochemical smog. The reaction of nitrogen oxides with hydrocarbons in the presence of sunlight to form ozone is an example of a photochemical reaction.
Abiotic depletion potential for non-fossil resources	kg Sb equiv/FU	ADP elements	Consumption of non-renewable resources, thereby lowering their availability for future generations. Expressed in comparison to Antimonium (Sb).
Abiotic depletion potential for fossil resources	MJ/FU	ADP fossil fuels	Measure for the depletion of fossil fuels such as oil, natural gas, and coal. The stock of the fossil fuels is formed by the total amount of fossil fuels, expressed in Megajoules (MJ).
Ecotoxicity for aquatic fresh water	CTUe/FU		The impacts of chemical substances on ecosystems (freshwater).
Human toxicity (carcinogenic effects)	CTUh/FU		The impacts of chemical substances on human health via three parts of the environment: air, soil and water.
Human toxicity (non-carcinogenic effects)	CTUh/FU		
Particulate matter	Kg $PM_{2.5}$ eq/FU		Accounts for the adverse health effects on human health caused by emissions of Particulate Matter (PM) and its precursors (NOx, SOx, NH3)
Resource depletion (water)	m^3 water eq/FU		Accounts for water use related to local scarcity of water as freshwater is a scarce resource in some regions, while in others it is not.
Ionizing radiation - human health effects	kg U235 eq/FU		This impact category deals mainly with the eventual impact on human health of low dose ionizing radiation of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.
Land use: transformation - SOM	kg C deficit/FU	LUO – SOM	Changes due to land transformation in Soil Organic Matter (SOM): the organic matter component of soil, consisting of plant and animal detritus at various stages of decomposition, cells and tissues of soil microbes, and substances that soil microbes synthesize.
Land use: occupation - biodiversity, ALL	PDF*m^2a/FU	LUO – B, all	Land occupation refers to a continuous use of land area for a certain human-controlled purpose, e.g. agriculture, forestry or buildings. This occupation avoids the land to go back to its original natural state. E.g. open mines.
Land use: occupation - SOM	kg C deficit/FU	LUT – SOM	Changes due to land occupation in Soil Organic Matter (SOM): the organic matter component of soil, consisting of plant and animal detritus at various stages of decomposition, cells and tissues of soil microbes, and substances that soil microbes synthesize.
Land use: transform. - biodiversity, ALL	PDF*m^2/FU	LUT – B, all	Land transformation refers to the change from one land use category to another; for example plantation of forest on land previously used for agriculture. Land transformation can be caused both by human activities and by natural processes.
Land use: occupation – biodiversity / urban, industry	m^2a/FU	LUO – B, u	This indicator includes only the flows of the indicator 'Land use: occupation - biodiversity, ALL' that relate to urban/industry land occupation (applied as an inventory method with characterisation factors set to (-)1 needed for the external environmental costing).

	Land use: occupation – biodiversity / agriculture	*m²a/FU*	*LUO – B, a*	*This indicator includes only the flows of the indicator 'Land use: occupation - biodiversity, ALL' that relate to agricultural land occupation (applied as an inventory method with characterisation factors set to (-)1 needed for the external environmental costing).*
	Land use: occupation – biodiversity / forest	*m²a/FU*	*LUO – B, f*	*This indicator includes only the flows of the indicator 'Land use: occupation - biodiversity, ALL' that relate to forest land occupation (applied as an inventory method with characterisation factors set to (-)1 needed for the external environmental costing).*
	Land use: transfomration – biodiversity / tropical forrest	*m²/FU*	*LUT – B, tr r*	*This indicator includes only the flows of the indicator 'Land use: transform. - biodiversity, ALL' that relate to land transformation to/from tropical forest (applied as an inventory method with characterisation factors set to (-)1 needed for the external environmental costing).*

UPTAKE AND EMISSIONS ASSOCIATED WITH BIOGENIC CARBON CONTENT

Indicator	Unit	A1 – Raw materials	A2 – Transport raw materials	A3 - Production	A4 – Transport to installation	A5 - Installation	B 2 - Maintenance	B 4 - Replacement	B 6 – Operational energy use	C1 - Demolition	C2 – Transport to end-of-life	C3 – Waste processing	C4 - Disposal	Module D
Uptake and emissions associated with biogenic carbon content of the biobased product	kg CO_2 eq.	*Not applicable*												
Uptake and emissions associated with biogenic carbon content of the biobased packaging	kg CO_2 eq.	*Not applicable*												
Since there is not yet sufficiently robust LCI data available to enable a coherent automatic calculation of the biogenic carbon emissions and removals, emissions and removals of biogenic carbon are presented only for the amounts present in the biomaterial in the finished construction product and in its packaging, and not for the amounts of biomaterial input required to make the product (e.g. packaging of raw materials used in A1-A3, biogenic carbon emissions and removals from grid electricity production).														

SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

A1 – RAW MATERIAL SUPPLY

See above "Composition and content"

A2 – TRANSPORT TO THE MANUFACTURER

Typical distance and transport modes, representative of the raw material supply transport are used as reference values.

A3 – MANUFACTURING

For generic EPDs, data for electricity and fuel consumptions at the manufacturing site correspond to average values from all families of products.

A4 – TRANSPORT TO THE BUILDING SITE

Prefabricated products for structural works come 100% from the factory to the construction site (Cf. B-PCR). Loose products (roof tiles, blocks…) are considered as coming 100% directly from the factory without an intermediate supplier. Indeed, for these products, the default distance of 100 km is an upper bound of total distance to building site, even in case of intermediate supplier.

Type of truck (payload max & EURO norms) & related diesel consumption	kg/km	24 t –10% EURO 3 – 0.270 24t - 40% EURO4 – 0.265 24t - 50% EURO 5 – 0.269
Distance	km	100
Loading rate (LR) : real payload/payload max	%	93.8
Empty return rate (ERR)	%	27%
Part of consumption linked to the weight of the truck	-	0.7
Part of consumption linked to the weight of the transported goods	-	0.3

Klik of tik om tekst in te voeren.

A5 – INSTALLATION IN THE BUILDING

At the construction site, packaging materials are released.

The modelled scenario corresponds to the typical installation of the concrete product in a building. Packaging of necessary installation products is not taken into account.

The impacts of the end-of-life of packaging and the material losses (0.5%) occurring during transport and installation of products are included in module A5.

Following materials are needed for mounting and/or installing the product:

A5, Installation in the building	**Unit**	**Value (per FU)**
Casting concrete	kg	115.2
Steel	kg	1.5
Electricity consumption	MJ	0.1

B – USE STAGE (EXCLUDING POTENTIAL SAVINGS)

The modelling of modules B1-7 follows the recommendations of the PCR for concrete and concrete elements (EN 16757:2017).

B1: Use or application of the installed product
This module only takes into account the carbonation process during the RSL. The carbonation process depends on the exposed surface of the product.
B2: Maintenance
There are no maintenance activities considered for precast concrete products except for architectural concrete in façade elements.

B3: Repair, B4: Replacement, B5: Refurbishment
No impacts are associated to modules B3-5. Indeed, according to EN 16757 "*In most cases, concrete elements have a longer RSL than the building, and no maintenance, repair or replacement is needed during the RSL of the considered unit*".
B6 and B7: Operational energy and water use
Operational energy and water uses are not included at the level of the EPD, even for precast concrete elements with an insulation function. The insulation benefits are expected to be accounted for in the effective energy consumption at the building level.

C - END OF LIFE

The end-of-life modules are based on the default scenarios defined in NBN/DTD B 08-001:2017

Module C2 – Transport to waste processing		
Scenario	Type of vehicle	Distance (km)
Sorting/collection centre	Truck Mix of EURO truck 3-4-5 24t payload max	30
Recycling centre		0
Incineration plant		100
Landfilling		50

End-of-life modules – C3 and C4		
Parameter	Unit	Value
Hazardous waste disposed	kg	0
Collection process	kg collected separately	218.4
	kg collected with mixed construction waste	54.6
Recovery system of concrete	kg for re-use/recycling	259.4
	kg for energy recovery	0
Recovery system of steel elements	kg for re-use/recycling	2.6
	kg for energy recovery	0
Disposal of concrete	kg product or material for final deposition	13.6
Disposal of steel elements	kg product or material for final deposition	0.1

ADDITIONAL INFORMATION ON RELEASE OF DANGEROUS SUBSTANCES TO INDOOR AIR, SOIL AND WATER DURING THE USE STAGE

INDOOR AIR

This section only applies to products that have an impact on indoor air quality. For exterior products, this section does not apply. According to the French CERIB analysis on indoor air quality (in accordance with the series of ISO 16000 norms), concrete precast products are classified in the A+ category (following the decree 2011-321 of the 23rd of March 2011). More specific data will be declared when the EN 16516 will deliver information on indoor air quality for concrete products.

SOIL AND WATER

No tests have been carried out to measure the release regulated of hazardous substance on the hollow core slab.
So there is no additional information on this subject.

DEMONSTRATION OF VERIFICATION

EN 15804+A1 serves as the core PCR	
Independent verification of the environmental declaration and data according to standard EN ISO 14025:2010	
Internal ☐	External☒
Third party verifier: Laurent Mbumbia Aarlenstraat/Rue d'Arlon 53-B9 1040 Brussels laurent.mbumbia@probeton.be	

ADDITIONAL INFORMATION – LCA INTERPRETATION

CARBONATION

The carbonation process is the process in which concrete parts exposed to air will reintegrate CO_2 from the atmosphere into their structure. The process speed depends mostly on the quantity of surface exposed to air and the amount of clinker used in the concrete. Modelling is based on the EN 16757:2017 PCR (Annex BB, "CO_2 uptake by carbonation — Guidance on calculation").

According to NBN/DTD B 08-001:2017, the GWP impacts related to CO_2 removals from carbonation are declared separately in the following table.

Carbonation				
	Concrete losses in module A4 & A5	*Use phase*	*During landfilling, in complement to use phase*	*During recycling as granulates (after crushing), in complement to use phase*
Unit: kg eq CO2	**Module A5**	**Module B1**	**Module C4**	**Module D**
GWP with carbonation (as in ch 7)	1.37E01	-1.76	8.66E-02	-5.88
Impact of carbonation	-8.27E-04	-1.76	-7.72E-02	0
GWP without carbonation	1.37E01	0	1.64E-01	-5.88

Negative values indicate net CO_2 removals.

As additional information, the potential maximum CO_2 uptake due to carbonation during the possible applications of secondary crushed concrete (beyond the system boundaries) is 1.01E01 kg eq CO_2 / FU.

INFLUENTIAL PARAMETERS

According to NBN/DTD B 08-001 :2017 (cf. A 29), the EPD has to include information on the most influencing parameters in the LCA.

The relative contributions of each module are first discussed for GWP impacts. For most products, the contribution of cement production in module A1 dominates the GWP results. Exceptions to this observation occur in cases where a large amount of materials is consumed in module A5 for installation (e.g. for the fibered pipe or the prestressed floorplate). For prestressed products, the GWP impacts associated to the production of virgin steel can be of the same order of magnitude as the cement production. Considering contributions in decreasing order of magnitude, reinforcing steel and/or insulating material come next, if present in the product. The other steps contribute less, with magnitudes depending on the product type.

Parameters contributing to other impact categories with a ranking very different from GWP results are pointed here:

- Particulate matter: the module C1 (demolition) dominates the results due to PM emissions modelled using ecoinvent data, recommended by the MMG document ("Milieuprofiel van gebouwelementen", OVAM, 2013).
- Stratospheric ozone depletion: dominating contributions are observed from energy consumption in module A3 and for A1-insulation. These impacts come namely from halon 1301. This elementary flow is still present in ecoinvent datasets, although this compound was completely phased-out by 2010.
- Abiotic resource depletion – elements: Steel production becomes the most contributing step (in cases of reinforced or prestressed concrete and especially in the presence of anchors, modelled as stainless steel).
- Water depletion: sand and aggregate extractions bring major contributions to module A1 and module D (in absolute value).
- Land use: sand and aggregates as well as packaging can become the most contributing steps.
- Acidification: pigments contributes, in relative, much more to this impact category (due to SO2 emissions, when producing titanium oxide through the sulphate process).

VARIABILITY OF RESULTS

According to EN 15804 (cf. 8.2.f.3) and NBN/DTD B 08-001 :2017 (cf. A 29), this declaration, as a collective EPD, has to include a description of the range of variability of the LCIA results (preferably quantitative)

As explained above, this collective EPD is based on average and most representative data and not on complete sets of specific data for each production site. Hence, individual results cannot be calculated and used to assess the range of LCIA result variability. Instead, two scenarios can be defined, in addition to the average scenario, for estimating minimum and maximum impacts.

Module & Data	Approach for determining values for min/max scenarios
A1 - Concrete composition	Min (max) values of impacts are calculated for min (max) values of cement percentage. Min (max) values of water percentage are counted simultaneously with the min (max) values of cement. The corresponding compositions of sand and aggregates are calculated so as to keep concrete volume constant.

Module & Data	Approach for determining values for min/max scenarios
A1 - Amount of steel	It is assumed that the amount of steel will only slightly vary from one producer or site to another, as they all face the same mechanical and economical constraints. A relative increase of 5% as compared to the nominal value and a decrease of 1% are considered in the amount of steel, independently of the variation of cement percentage.
A1 - Amount of pigments	It is assumed that the amount of pigment can vary by +/- 10% relatively to the nominal value.
A2 - Transport from extraction to manufacturer	For max values: shift from barge to truck or additional distances by truck. (Min values are equal to default values)
A3 - On-site manufacturing	It is assumed that for a same product, the electricity and fuel consumptions among sites will be at the minimum and at the maximum respectively 33% and 300% of the calculated average values. This interval reflects more the uncertainty on the data than the expected variability for a same product (energy data are based on an average of all manufacturers, common to all prefab concrete products).
A3 - Packaging	No variability is modelled, except for some families of products for which a lower bound without pallet is investigated (e.g. paving flag).

The analysis of variability has been carried out for 13 products representing the families of FEBE prefab products.

The variability of cradle-to-grave GWP results for the considered min and max scenarios is discussed in percentage around the average scenario, taken equal to 100%. Variability is only modelled for modules A1 to A3. Hence the amplitude of the interval between the min and max results depends mainly on the relative contributions of modules A1-A3 to the total impacts. For example, if module A5 has a high impact, it will reduce the variable part of the results.

For GWP, results are in the range of -8% to +17% for most products. Min or max results are observed outside this range for:

- roof tile with pigments (+32%), because there is a large variation in cement content for this concrete recipe, at the upper bound, and the cement production dominates the results for this product;
- prestressed beam (+23%), because steel production contributes as much to GWP results than cement production and other steps contribute much less; the variability of both steps adds to each other;
- paving flag with white cement (-11%), because there is a large variation in cement content for this concrete recipe, at the lower bound, the white cement production dominates by far the results for this product.

The calculations for all products show that the energy consumption in module A3 is the step with the largest variability in GWP results (although this step is never in the most contributing ones). As mentioned above, this variability reflects more the uncertainty on this module A3 than the expected variability among producers. If the variability on energy consumption is removed, min and max GWP results lies between -8% and +16% for all products and between -7% and +8% without the roof tiles with pigment, prestressed beam and white paving flag.
The remaining variability is dominated by the variability of cement content in the concrete recipes.

For other impact categories, ranges of variability are inside the intervals defined for GWP except for the following categories:

- Abiotic depletion – fossil: this indicator is still more sensitive to the variability of energy consumption in module A3.
- Stratospheric ozone depletion: this impact category is also sensitive to the variability of energy consumption in module A3; However, this impact category is not an issue for prefab concrete products and the limited data quality on the contributing elementary flows prevents a robust analysis of the results.
- Water depletion, land use and eutrophication, in some cases.

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- EN 16757:2017, Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements
- CERIB documents on indoor air quality: ‘Contribution des produits en béton à la qualité de l’air intérieur’, February 2013

General information

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Author(s) of the LCA and EPD	LCA model and EPD tool developed by RDC Environment for FEBE Elisabeth van Overbeke, Elisabeth.vanoverbeke@rdcenvironment.be
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	www.environmentalproductdeclarations.eu

Comparing EPDs is not possible unless they are conform to the same PCR and taking into account the building context.
The program operator cannot be held responsible for the information supplied by the owner of the EPD nor LCA practitioner.

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